REMARKS

Claims 14-20 and 22-27 were rejected pursuant to 34 U.S.C. §101 as being directed to non-statutory subject matter. Both claims 14 and 22 are directed to statutory subject matter. The transformation of data representing a patient into an image is directed to statutory subject matter (See In re Bilski).

In the Office Action, the Examiner again rejected claims 1, 3, 5, 11-14, 16, 18, and 24-26 pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. (US 6,526,163) in view of Seiler, et al. (EP 1,093,085). Claim 2 was rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Seiler and further in view of Zar (A Scan Conversion Engine...). Claims 4 and 17 were rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Seiler, et al and Hossack, et al. (US 6,352,511). Claims 6 and 19 were rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Seiler, et al. and Okerlund, et al. (US 6,690,371). Claims 7 and 20 were rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Seiler, et al. and Drebin, et al. (US 4,835,712). Claims 9 and 22 were rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Seiler, et al. and Swerdloff (US 5,483,567). Claim 15 was rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Seiler, et al. and Fattah (US 7,274,325). Claim 27 was rejected pursuant to 35 U.S.C. §103(a) as unpatentable over Halmann, et al. in view of Seiler, et al. and Edic, et al. (US 2004/0136490).

Claim 8 was allowed. Claims 10 and 21 were objected to as being allowable if amended into independent form.

Applicants respectfully request reconsideration of the rejections of claims 1-7, 9, 11-20, and 22-27, including independent claims 1 and 14.

Independent claim 1 recites a processor operable to identify acquired ultrasound data as a function of the values where a look-up table has the values corresponding to a spatial conversion from the display format to the acquisition format.

Halmann, et al. do not disclose this limitation. Halmann, et al. note that a CPU generates the scan converter tables necessary to convert scanned data from the polar coordinate system to the Cartesian coordinate system where the tables are dependent on the mode of

operation (col. 7, lines 54-59). Scan conversion is performed with interpolation and the like (col. 8, line 53-col. 9, line 4). Halmann, et al. do not provide further details for the tables, but indicate that the tables convert the data. Halmann, et al. do not use values of the table to identify ultrasound data. There is no teaching that acquired ultrasound data is identified as a function of the values of the look-up table.

The tables of Halmann, et al. would be used by applying each ultrasound datum to the table. The table then provides for conversion of the ultrasound data. Each datum is converted, so the identity of a given ultrasound datum is not needed. The original data is converted regardless of identity.

Claim 1 recites that the table has values corresponding to a spatial conversion from the display format to the acquisition format. Halmann, et al. convert polar coordinates into Cartesian coordinates (col. 7, lines 55-57; and col. 8, lines 64-65), not a look-up table used for the inverse conversion of Cartesian coordinates to the polar coordinates.

The Examiner alleges that, since the scan conversion is converting the polar scanned data to display values, it is identifying the polar data as a function of the Cartesian values, and alleges that the look-up table is reversible. However, Halmann, et al. do not disclose the structure of the lookup table. The lookup table, to be used for scan conversion, likely has interpolation values (not a Cartesian coordinate) given an input Polar coordinate. The interpolation values are then applied to the data for that Polar coordinate to weight the data and create Cartesian data. The table is likely for interpolation values for the actual conversion of data at particular coordinates, so would not have a Cartesian coordinate output given a polar coordinate input.

Even if the table is addressed by scan coordinates, to use inversely, the specific interpolation values, not a Cartesian coordinate, would be needed to address the table. For example, the table would be addressed by polar coordinate to output interpolation weights (e.g., 0.93). These interpolation values correspond to spatial relationships, so may be identical for different locations. Using the table in reverse would result in multiple polar coordinates given an input interpolation value.

Even if reversible, Halmann, et al. convert polar coordinate data to Cartesian coordinate

data. There is no reason to identify polar coordinate data from or starting with a Cartesian coordinate. The process flows by providing polar coordinate data. The polar coordinate data is then interpolated (weighted and summed) to represent data at a Cartesian coordinate. The location of the Cartesian coordinate does not need to be known before hand. The available polar coordinate data is converted. An inverse lookup would not occur.

Independent claim 1 further recites that the processor is operable to avoid scan-conversion of volume data that does not contribute to a final volume rendered image, the identifying corresponding to identifying for display format coordinates associated with visible voxels of the final volume rendered image. Halmann, et al. and Seiler, et al. do not disclose these limitations.

Halmann, et al. simply scan converts all the incoming polar coordinate values for imaging. All the scan conversion tasks are completed so that a 2D image is generated (col. 9, lines 4-13). Volume rendering is performed from the 2D images (col. 5, lines 34-40). Halmann, et al. rely on polar coordinate to Cartesian coordinate scan conversion, converting all of the frames of data to provide 2D images, and then perform volume rendering from the 2D images. Halmann, et al. do not operate scan conversion as a function of the volume rendering, so do not avoid scan-conversion of volume data that does not contribute to a final volume rendered image, the identifying corresponding to identifying for display format coordinates associated with visible voxels of the final volume rendered image.

The Examiner takes a mere general statement about generating scan conversion tables and alleges obviousness of the claim, indicating hindsight reasoning.

Seiler, et al. also do not avoid scan conversion. As known in the art and recited in the claim, scan conversion corresponds to a spatial conversion from a two-dimensional acquisition format to a two-dimension display format. Seiler, et al. do not disclose scan conversion. Instead, a volume of data is the starting point (paragraphs 2, 8, and 34-35). Volume sections are reviewed to avoid transfer for 3D rendering of 3D voxels. Seiler, et al. start with volume data and avoid 3D rendering of voxels, so do not avoid scan conversion.

A person of ordinary skill in the art would not have used the avoidance of transfer of voxels with the scan conversion of Halmann, et al. Seiler, et al. use as input a volume set of

data. Halmann, et al. generates 2D images by scan conversion (col. 9, lines 4-13). A collection of the scan converted images are used to form a volume data set for rendering. (col. 5, lines 33-40). Halmann, et al. treat scan conversion and rendering separately. A person of ordinary skill in the art would have used the voxel control for rendering of Seiler, et al. with the rendering of Halmann, et al., not the different scan conversion process.

A person of ordinary skill in the art would not have used the voxel transfer avoidance of Seiler, et al. with the scan conversion of Halmann, et al. for another reason – failure to enable. Seiler, et al. rely on the data in a volume arrangement or volume sections extracted from the volume data to determine which voxels not to use. The view direction, size of the volume, equations for cut and crop planes in the volume, and bounding boxes are volume related factors used to select voxels (paragraphs 77 and 78). The volume data set is needed to even determine these factors. As of the scan conversion of Halmann, et al., the volume data set is not yet created. A person of ordinary skill in the art would not know how to use voxel selection in the scan conversion process as Seiler, et al. provide a process for a rendering pipeline with the volume data as a starting point.

Using 3D rendering voxel transfer avoidance of Seiler, et al. in the scan conversion of Halmann, et al. is using improper hindsight reasoning.

Independent claim 14 is allowable for similar reasons as claim 1.

Dependent claims 2-7, 9, 11-13, 15-20, 22, and 24-27 depend from claims 1 and 14, and are allowable for the same reasons as the corresponding base claim. Further limitations patentably distinguish from the cited references.

Claims 3 and 16 recite determining the display coordinates of interest and identifying the acquired ultrasound data by input of the display coordinates into the look-up table. The Examiner cites to col. 8, lines 4-9 of Halmann, et al. Halmann, et al. may locate an area of interest, but the area is not used to identify acquired data by input into the look-up table. Identifying all ultrasound data is not using the area to identify data.

Claims 5 and 18 recite the display coordinates of interest input to the look-up table being coordinates for a plurality of rays through the volume. Halmann, et al. disclose a raycasting/volume rendering module 201, but this module 201 is not shown to work with the

tables of the separate scan conversion module 207. The Examiner alleges there is no way to render an image if the original coordinates are polar, but that is not true. The rendering can account for any coordinate system. The rendering, rather than scan conversion, may provide data for each pixel based on ray casting, regardless of the format of the input data. Halmann, et al. do not put ray coordinates into a scan conversion look-up table.

Claim 11 recites a graphics processing unit (GPU). GPUs are typically used in 3D rendering. As noted by the Examiner, GPUs are well known yet Halmann, et al. use CPUs. The nature of the scan conversion process is such that GPUs are not used. It would not have been obvious to use a GPU in scan conversion.

Claim 26 recites generating a two-dimensional look-up table with acquisition format coordinates for each coordinate of a Cartesian volume. Halmann, et al. treat volume rendering separately from scan conversion. There is no disclosure of a LUT for coordinates of a Cartesian volume. The Examiner alleges there is no way to render an image if the original coordinates are polar, but that is not true. The rendering can account for any coordinate system. Also, the process of Halmann, et al. may be used – convert from Polar to Cartesian. The image is rendered from a volume of Cartesian data, so a reverse table would not be used.

Claim 2 recites values of the look-up table being Polar coordinates where the look-up table is indexed by integer Cartesian coordinates. Halmann, et al. do not disclose coordinate values in the look-up table, and do not disclose Polar coordinates as the values of the look-up table indexed by Cartesian coordinates. Col. 7, lines 50-58 show conversion of scanned data to a different coordinate system, not coordinate values. Zar discloses bilinear interpolation of ultrasound data, not a look-up table of coordinates.

Claim 4 recites the processor operable to determine a plane through a volume as the display coordinates where the display coordinates are input to the look-up table. Hossack, et al. show arbitrary plane display for a volume, but do not use the coordinates of the plane as an input to the look-up table. Halmann, et al. treat volume rendering and scan conversion separately, so do not use coordinates of a plane in a volume as input to the scan conversion table. The form of conversion used would be the form taught by Halmann, et al., not a

reverse conversion that also intermixes the separate rendering process. Claim 17 is allowable for similar reasons.

Claims 6 and 19 are allowable for the same reasons as claim 5. Claims 6 and 19 are also allowable because a person of ordinary skill in the art would not have used the cited rendering of Okerlund, et al. with Halmann, et al. The cited section for alpha blending of Okerlund, et al. teach a hardware based RGBA approach (col. 7, lines 4-19). Alpha blending is provided using hardware acceleration. However, Halmann, et al. desire versatility so use programmable CPUs to avoid hardware specialization (col. 2, lines 42-52). A person of ordinary skill in the art would not have used the hardware acceleration based alpha blending of Okerlund, et al. with the general programming approach of Halmann, et al. The Examiner alleges that the methods are compatible. However, CPU based rendering and hardware acceleration are alternatives being compatible is not the test. Being compatible is not the test. A person of ordinary skill would not have used rendering in scan conversion.

Claim 12 recites a flag, and an integer sum. As noted in the specification, an integer sum allows indication of spatial relationship relative to other table entries. Halmann, et al. do not suggest any format for the look-up table, and certainly do not disclose an integer sum, a flag or fixed-point values. These values are chosen to allow table based identification of data rather than scan conversion of the data. Selective scan conversion of only the samples that contribute to the rendering result without having to scan convert occluded data is provided by the recited table variables. A person of ordinary skill in the art would not have provided the listed classes as a mere design choice. The flag and integer sum would not have been considered as there is no reason for them in Halmann, et al. Just being well knowN is insufficient.

CONCLUSION:

Applicants respectfully submit that all of the pending claims are in condition for allowance and seeks early allowance thereof.

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